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CLOVER FARMING ON THE SANDY JACK-PINE LANDS OF THE NORTH.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., March 4, 1908.

SIR: I have the honor to transmit herewith a paper entitled "Clover Farming on the Sandy Jack-Pine Lands of the North," by Mr. C. Beaman Smith, Assistant Agriculturist, prepared under the direction of the Agriculturist in Charge of Farm Management Investigations of this Bureau.

Large tracts of sandy pine lands occur in several Northern States, particularly in Michigan, Wisconsin, and Minnesota, which by ordinary methods of farming do not give profitable returns. It has been proved that when special care is taken in handling these lands and special crops are grown a large part of the sandy pine lands can be built up into profitable farms. The growing of clover for seed is one of the special lines that have proved profitable. Exceptionally good yields of high-grade clover seed are now being grown on some of this land, and it is believed that the clover crop, whether for seed, for forage, or for green manuring, is the key to the situation for successful farming on this land.

The manuscript herewith gives a detailed account of the methods of handling the soil and growing clover followed by successful farmers on this land. The data presented apply to many million acres of land in the North now idle because people do not know how to handle them. I therefore recommend that the paper be published as a Farmers' Bulletin.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

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CLOVER FARMING ON THE SANDY JACK-PINE LANDS OF THE NORTH.

INTRODUCTION.

The sandy jack-pine plains of the States of Michigan, Wisconsin, and Minnesota have long been an agricultural problem. Farmers have generally failed to make a living on them. After building a house and barn, clearing up a patch of ground and cropping it for two or three years, the land has been abandoned. The crops raised were not sufficient to support the farmer or to encourage him to stay longer. More people have left these lands during the last thirty years than are now living on them.

The problem has been whether these lands could ever be farmed profitably or whether they had not best be used for forestry purposes. The recent successes of numerous farmers in growing clover and producing clover seed on these jack-pine lands indicate that a solution has at last been found for profitably farming at least a part of this hitherto rejected land.

This much has been demonstrated: These sandy jack-pine lands can not be farmed in the usual manner with profit. General farming fails. Success will come only from growing specific crops adapted to the soil and climate, and thus far the crop found most profitable is clover for seed. This is a most fortunate circumstance. With clover for a start, either for seed or forage, the land can soon be built up into almost any state of productiveness. It would seem that the key to the successful farming of these lands has been found.

EXTENT AND CHARACTER OF THE JACK-PINE LANDS.

There are perhaps 2,000,000 acres of jack-pine lands in Michigan alone, the bulk of it occurring in the northern central portion of the lower peninsula. In addition there are 8,000,000 or 9,000,000 acres of cut-over pine lands that are generally of a light sandy nature and require specially careful handling to make them productive of farm crops. In Wisconsin there are probably as many as 2,000,000 acres of jack-pine lands, and in Minnesota there are considerable areas of

jack-pine and light sandy pine lands. Small areas of land of very similar character are found as far east as Maine.

The typical jack-pine plains are generally rather openly wooded and often park-like in appearance. Jack pine (*Pinus banksiana*) is the common timber, and this is found in all stages of growth from seedlings to trees 35 to 50 feet high. Scattered with the jack pine are scrub oaks, poplars, willows, Juneberry, chokecherry, and other woods of shrubby growth. The small native vegetation consists for the most part of brakes, sweet ferns, huckleberries, wintergreens, and some rather coarse wild grasses. In the autumn golden-rod and wild asters are conspicuous.

The soil is usually a rather light yellow, brown, or gray sandy loam, often of a gravelly nature. Frequently red clay comes to the surface and is sometimes several acres in extent. Generally the subsoil is sandy, often to great depths. Analyses^a show that the better grades of jack-pine soils are well supplied with the mineral elements necessary for plant growth, but are generally quite deficient in humus and nitrogen. This lack of humus and nitrogen is one of the fundamental reasons for the low productiveness of the jack-pine plains.

As with other lands, the jack-pine soils vary greatly in value for agricultural purposes. Generally that which is most open, sandiest, and most thinly covered with native grasses and other vegetation is the least productive. A thick mat of vegetation or dense underbrush containing many briars, willows, Juneberries, poplars, scarlet maples, etc., indicates a more productive quality of soil. The intending purchaser should carefully examine the land before he buys it.

ATTRactions OF THE JACK-PINE LANDS.

The jack-pine land attracts farmers (1) because it is cheap, and (2) because it is easily cleared. It looks as though one could easily make a good farm out of it. Frequently a man can clear 2 or 3 acres a day and get it ready for the plow. The timber being small, most of the stumps can be plowed out the first year and by the second or third year the rest are rotted. This phase appeals to the man who has seen the labor and time taken to clear up a heavily timbered piece of land and get rid of the stumps.

The cheapness of the land, however, is undoubtedly the main reason for settlers occupying it. Much of it has been homesteaded. A good deal of it has had the scattering pine cut off by lumbermen and has reverted to the State or can be bought for back taxes. Thus secured the land costs 25 cents to \$1.25 an acre. In other cases speculators have bought up the land and by advertisement and otherwise are

^a Michigan Agricultural Experiment Station Bulletin No. 37.

inducing families to settle on it. Speculators are holding it for \$5 to \$15 an acre.

The sandy pine stump lands present a different problem. The lumber on these lands was largely Norway and white pine. It takes a lifetime or more for the stumps of these trees to rot, while to pull or dynamite them out costs \$15 to \$25 an acre. The principles of farming are the same on the sandy Norway and white pine stump land, however, as on the jack-pine plains land.

REASONS FOR FAILURES ON THE JACK-PINE LANDS.

The principal reason why farmers have failed on the jack-pine lands is because they attempted to grow grains, roots, and grasses in the same way that they had been accustomed to on the heavier and more productive lands in other sections of the country. The methods of farming observed on heavier, more fertile lands fail here. The plains land is light. It is subject to drought. It is lacking in both humus and nitrogen. The yields by usual farming methods are increasingly disappointing from year to year. On average jack-pine lands handled in the usual manner potatoes will give as a first crop on spring breaking 35 to 60 bushels per acre, wheat 5 to 6 bushels, rye 5 to 8 bushels, oats 10 to 15 bushels and usually light in weight.

Other reasons for failure are deep plowing, burning off the humus, clearing the land at the wrong season of the year, and failure to recognize that the land is light, not adapted to general farming, and needs first of all to be built up with humus and nitrogen before either satisfactory crops of grain, roots, vegetables, or fruit can be grown. Success in farming this land will come from growing special crops like clover seed, potatoes, or truck, not from general farming.

FACTS EVERY SETTLER SHOULD KNOW.

The intending settler on the jack-pine lands needs to know at the outset that this sandy soil needs a little nursing and special care in handling. The land has been repeatedly burned over every few years for no one knows how many generations; hence, there is little humus or vegetable matter in it. It lacks nitrogen. It is likely to be a little leachy. It is likely to suffer severely in time of drought. It needs protection from the winds. In the beginning it should be plowed shallow. It usually needs rolling to make a firm seed bed, followed immediately by dragging to make a dust mulch for retaining the moisture in the soil and to reduce the velocity of the wind next to the soil surface.

On the other hand, when such sandy land is properly handled it responds with marvelous quickness to even small quantities of barn-yard manure, green manure crops, or commercial fertilizers. It pro-

duces splendid crops with barnyard manure alone. The land can be handled whenever the sun shines. It produces a crop ten days to three weeks earlier than the heavy clays, and in the case of orchard fruits sometimes two to five years sooner. Besides, the quality of many crops grown on sandy land is superior.

CLEARING AND BREAKING JACK-PINE LANDS.

The successful handling of the jack-pine plains begins with the clearing of the land. The logs, brush, and stumps must be cleared away, but nothing should be burned off that can be plowed under for humus. The great need of the soil is for humus, or vegetable matter. Rotten logs should be picked to pieces and scattered thinly over the ground. All the sweet ferns, huckleberry bushes, brakes, and other small growths should be plowed and not burned off.

Burning over the soil not only depletes it of its humus content, but tends to make a sterile and dead soil of it, since the bacterial life which has so beneficial an action in the production of crops is for the most part active only near the surface of the soil. A fierce fire left to run over the land in clearing it will destroy most of these beneficial organisms, leaving the soil inert and unresponsive, like a freshly turned subsoil.

One of the most successful farmers found on the jack-pine plains clears his land and burns the log and brush heaps in the spring or fall, but makes it his general practice not to break the land until about the middle of July. By this time all the native vegetation, such as the ever-present brakes, sweet ferns, huckleberries, wintergreens, wild grasses, etc., has made its principal growth for the season. This mass of weeds, grasses, and shrubby growths is then plowed down by the aid of a chain attached to the end of the whiffletree and beam of the plow in the usual manner for plowing under green crops. When the land is broken up in the spring for crops, the roots and underground stems of the native vegetation, being full of stored food, start into a vigorous growth, producing stems, leaves, and new plants above ground, which seriously compete with the planted crops for moisture and a place to grow. These roots continue to send up stems all summer long, which necessitates continuous cultivation to subdue them.

On the other hand, when the land is not broken up until July and early August, the roots have become practically exhausted of their stored food supply in producing the growth of stems and leaves above ground. If at this time the ground is plowed and the exhausted roots turned up to the hot July sunshine, the plants are more easily and surely killed than at any other time of the year.

After plants have made their full growth above ground for the season they begin storing food in their roots and stems again for early

spring growth the following season. For this reason fall breaking likewise is less effective for subduing the native vegetation than summer breaking, because the roots, being full of stored food at the time of the late plowing, start into growth promptly the following spring, being but little injured in that northern climate, where the snow usually covers the ground all winter.

There is still another reason for waiting until midsummer before breaking the land. By that time there is a heavy growth of vegetation. This makes as good a green manure crop to turn under as rye or buckwheat would.

DEPTH TO PLOW JACK-PINE LANDS.

The jack-pine lands are light and thin. What humus they contain is for the most part within 2 or 3 inches of the surface; below that is subsoil. Now, in actual practice the men who are making the greatest success on these lands are plowing but 4 to 5 inches deep. Usually the nearer 4 inches deep the land can be broken up the better the succeeding crop will be. The depth of plowing is only gradually increased as humus and nitrogen are added to the soil. It will probably be found that about 6 inches is as deep as it will ever be found necessary or desirable to plow the lighter lands of the jack-pine plains.

On the more loamy or even clay lands sometimes found on the jack-pine plains the plowing after the land has been enriched with humus can be gradually deepened to 7 or 8 inches; but at the first breaking 4 inches has proved deep enough on any kind of jack-pine land. This point is emphasized here because so many settlers in this region make the serious mistake of burning the land over in the spring to slick it off clean for the plow and then plow it 7 to 8 inches deep. This is a mistake. It puts the thin streak of humus in the surface soil down about 6 inches deep, leaving 3 inches at least of dead subsoil on top of the ground. Seeds started in such a topsoil make a discouraging growth. Clover particularly makes a much better growth when the first breaking is less rather than more than 4 inches deep; and this is the plant above all others that should be encouraged, as it promises to convert these hitherto discouraging lands into profitable farms.

Special attention is called to the desirability of breaking these lands shallow. Successful farming on these lands is absolutely dependent upon the observation of a few apparently insignificant points which on better soils might be overlooked with impunity, but which on these naturally light soils must be observed if productive, prosperous farms are to be built up.

PREPARATION OF THE SEED BED.

After the land has been broken up in July and the natural green manure crop of native vegetation plowed under about 4 inches deep, it should be gone over with a roller heavily weighted to pack the loosened soil down firmly. This hastens the rotting of the material turned under. The spring-tooth harrow is commonly employed on this land because with it many of the brakes and other roots which cause so much trouble by continuously springing into life when the land is spring or fall plowed are pulled out and can be gathered up and burned.

That is just what ought not to be done. Leave the trash and roots in the soil. Their decay there means the addition of just so much more humus to it, the thing above all others of which the soil stands most in need. The disk harrow, which cuts the roots up and leaves them in place, is a much more satisfactory implement to use in first working down new breakings. By the use of the disk harrow after the roller, any new growth that comes up between the time the land is broken in July and the time grain is sown in the fall can be easily kept in control. The disk should not run more than about 3 inches deep and should be set at only a slight angle. Where the disk is not available, a spike-tooth drag with the teeth slanting slightly backward is the next best implement to use.

If, however, the land is broken in early spring, when the roots and underground stems are filled with stored food, it will be advisable to drag out as many roots and stems as possible in order to reduce their numbers in the field during the growing season.

CLOVER THE KEY TO SUCCESSFUL FARMING ON JACK-PINE LANDS.

The vital fact in farming the sandy jack-pine lands is that clover will grow on it. A second fact is that clover builds up the land faster than any other crop commonly grown there. It supplies at the start both the nitrogen and humus that the soil so badly needs. A third fact is that by growing the crop for seed the enriching effects of the clover on the land can be secured and at the same time a cash crop of greater value than that from any other crop commonly grown on the jack-pine lands obtained. This is a point of paramount importance to the poor settler, who needs every cent he can get off the farm to meet his living expenses. Finally, as a green manure clover is the best crop yet found for the jack-pine plains.

In some sections, particularly in Michigan, very profitable returns have been secured from growing mammoth and common red clover for seed. These lands seem well adapted to clover-seed production. Yields of seed ranging from 2 to 6 bushels to the acre, haying a gross

cash value of \$10 to \$50 per acre, have been obtained. For the last few years the seed yield has averaged a little more than 3 bushels to the acre. As the price ranges between about \$5 to \$9 per bushel, this makes a very profitable crop. The income from clover-seed farming is thus seen to be as great as that from land yielding 20 bushels of wheat or 40 bushels of corn to the acre at average prices. But whether or not one grows clover for seed or goes into some other kind of farming, such as the dairy industry, sheep, potatoes, and the like, it is certain that clover lies at the base of every successful system of farming that has yet been devised for these lands and should be among the very first crops grown.

KIND OF CLOVER TO GROW.

Of the different kinds of clover the mammoth, bull, or sapling clover rather than the smaller common red clover or the alsike clover has been found most efficient on the jack-pine plains. It seems to grow better, gives more forage, and yields more seed to the acre than either of the other two varieties. The mammoth clover, of course, produces but one crop of hay a season, but most of the plains land is so far north that only one cutting can be safely taken from any kind of clover, while in that section cutting the first crop of common red clover for hay and the second for seed generally results in a very light and unprofitable crop of seed.

HOW TO SECURE A STAND OF CLOVER.

The first matter for the settler on the jack-pine plains to consider is how to secure a good stand of clover.

SEEDING CLOVER WITHOUT A NURSE CROP.

The surest way to get a stand of clover on jack-pine lands is to seed the crop alone without a nurse crop. Where the land has been broken up in July by plowing down the native vegetation 4 inches deep and rolling with a heavy roller, followed by an occasional cultivation until fall with a disk harrow or spike-tooth drag, the land will be in the best possible condition for seeding to clover about May 1 of the following spring.

Now, on that light sandy land it has been found best to drill or drag the clover seed in about 2 inches deep. Seeding the clover in spring on top of the land with fall-sown grain, as is the common practice on heavier lands, fails nearly every time it is tried on these light sandy lands. On the other hand, where the seed is put in about 2 inches deep it is able to withstand the usual drought which commonly occurs in those northern climates in May. Being rooted at least 2 inches deep, it is not so easily blown out or injured by the wind,

which usually blows strongly from the west or southwest during the spring months. Many failures to secure a stand of clover on the jack-pine plains are due to shallow spring seeding and the drying up or blowing out of the plants by the persistent western winds common early in the year.

Another point in this connection is that by seeding 2 inches deep, the clover rootlets, after elongating an inch or so, come into immediate contact with the body of humus produced by turning under the mass of wild vegetation 4 inches deep at the time of breaking in July. Practically all of the available plant food of the soil is thus within easy reach of the clover rootlets just at a time when the plants are weakest and stand most in need of it. This decayed matter gives the clover plant a vigorous start until tubercles can be formed on the roots and the plants thus made able to secure their nitrogen from the air. The fact is now generally known to all farmers that the more tubercles or nodules found on the roots of the clover plant the greater the growth of the clover and the more valuable the crop for green manuring.

The seeding of the clover alone without any nurse crop whatever is especially advantageous on these light soils. It insures, in so far as it is possible by any method of farming to insure, a full stand of clover and after the land becomes fertile enough the production of a fair hay crop that same season. By this method of seeding, all the moisture of the soil and all the available plant food in the soil are put at the service of the clover plant.

When the clover is seeded with a grain crop it must compete with the grain crop for both moisture and food. The result is usually an inferior, unprofitable crop of grain and frequently only a half stand or an entire failure of the clover. Weeds which in other sections of the country may hinder the growth of clover seeded alone in spring do not make trouble on this new land when broken up in mid-summer and occasionally cultivated.

SEEDING CLOVER WITH A NURSE CROP.

The financial conditions of many farmers who move on the jack-pine lands are such that they must grow their own forage and grain in sufficient quantities at least for their own stock. With most farmers on the jack-pine plains the need is immediate of growing some money crop as quickly as it can be secured. For these and other reasons it will be found necessary to grow a certain amount of grain, forage, and root crops from the start, drawing on the fertility already in the soil for their production. At the same time it is desirable that the ground be seeded with clover, so that the building up of the soil may be begun as quickly as possible.

With a favorable season, particularly one with plenty of rainfall, a good stand of clover may be secured by seeding with grain. In fact, it should be an invariable rule on the jack-pine lands always to seed clover with every grain crop put in. The clover may fail sometimes as a crop, but enough will usually catch to make it profitable to turn under for green manure and thus pay for the seed at least. Winter rye is a favorite crop to seed with, since it usually gives a larger yield on the light lands of this section than any other grain. If the land is broken up in July, as previously described, it will be in good condition for seeding to winter rye about August 25 to September 5 anywhere north of central Michigan and Wisconsin. This is a little too late to seed with clover, which should be put in as soon as the snow goes off the following spring. There are right and wrong methods of doing this.

As to the right method, as soon as the ground can be worked in spring run over the rye field with a spike-toothed harrow lengthwise of the rows. Sow on mammoth clover seed at the rate of 3 to 4 quarts, or 6 to 8 pounds, to the acre. Then run over the field again with the spike-toothed harrow with the teeth slanting back a little and follow with the roller. If the season is dry, cut the rye for hay and give the clover a chance.

This quantity of clover seed is entirely sufficient where it is intended to cut the clover for seed the following year. If the crop is intended for forage, then 6 to 8 pounds of orchard grass or timothy seed sown with the grain in the autumn will insure a larger hay crop the following year.

The harrowing will not injure the rye in the least, and it will cover the clover seed a little deeper than when sown on top of the ground and then dragged in. It is inviting failure to seed the clover on top of sandy soils and not harrow it in.

If wheat is sown in the fall instead of rye the wheat should be harrowed in the spring and the clover sown in exactly the same manner as noted for rye. Seeding clover with spring grains has been practiced by a large number of successful farmers on the jack-pine lands. This method has been quite successful during the past three or four wet years. But where the main purpose is to secure a crop of clover, this method is never so certain as seeding the clover without a nurse crop.

Perhaps three-fourths of the farmers visited on the jack-pine lands consider buckwheat one of the best grains to seed with; that is, they report the best catch of clover with this crop. Clover has also usually caught better in spring rye than in spelt or oats. In many instances also good catches have been secured with Canada field peas. Excellent catches have also been secured when clover was

seeded in ruta-bagas in July. In fact this is one of the best crops of all to seed with when the ruta-bagas are sown in rows, the clover being planted between the rows at the last cultivation about the middle of July. For the region about Roscommon, Mich., Mr. F. L. De Lameter recommends the seeding of clover with oats or spelt up to May 15; with millet, buckwheat, or turnips up to June 20; and with rye or wheat up to August 15.

When clover is seeded with any of the spring grains it is safe and advisable to drill the clover in with the grain, letting the clover seed run down the grain tubes. This puts the clover seed down 2 to 3 inches deep, which is none too deep on light land. If the grain is broadcasted by hand, the clover seed, of course, is dragged in the same depth as the grain. In any case, whether the grain is drilled or harrowed in, it is advisable to follow the drill with a heavy roller to pack the soil down firmly around the seed, followed by a spike-tooth harrow to leave the topsoil rough and loose. A rough soil drifts much less than a smoothly packed soil, and moisture is retained to a greater extent when the topsoil is loose than when it is firmly packed down.

It should be a rule on the jack-pine lands to sow on clover seed at every opportunity, with every grain and grass crop, in the standing corn at the last cultivation, with ruta-bagas or turnips, and with every crop with which it will not interfere. As one farmer expressed it "Every time you scratch the ground, put in clover seed." But in dry or otherwise unfavorable seasons all the clover thus seeded may fail. In addition, then, to the clover thus seeded it is strongly urged that the main fields of clover, the ones in the regular rotation that are being depended upon for clover seed, be seeded alone. This method of clover farming insures a seed crop every year on a third to a fourth of the whole farm.

CLOVER INOCULATION.

When new land on the jack-pine plains is cleared and put into clover for the first time, it sometimes makes only a small growth. This is not necessarily because the land is poor, but is often because the soil is not well inoculated with clover bacteria.

In a thrifty clover field the roots are usually thickly studded with small tubercles. When clover is grown on virgin soil like the jack-pine plains, the organisms causing these tubercles are not plentiful or may be entirely wanting. In an examination of a number of fields of clover on the plains land many cases were found where there was only now and then a tubercle on the roots, or the tubercles might be entirely absent.

Now, the poorer the land the greater the need is of having the soil well inoculated with the bacteria causing these tubercles. It is by means of bacteria working within these tubercles, or nodules, that the clover plant is able to utilize the nitrogen of the air in its more rapid and vigorous growth.

There are three common ways of getting the soil inoculated with clover bacteria:

(1) When the seed is sown in the usual way nearly always some of the plants become inoculated. This is particularly true where old logging or other roads cross the fields. The field as a whole may be unsatisfactory. If this field is plowed and harrowed and clover immediately sown on again the chances are that the second crop will be much more vigorous than the first, because of the more abundant inoculation of the soil brought about by the greater distribution of the bacteria in the soil by plowing and harrowing, by the wind, etc. So if clover does not succeed the first year, it may be tried on the same land the second year. By the third year the field should be thoroughly inoculated and a good stand obtained. After that the field should remain inoculated for years.

(2) A second and very common way of inoculating new land with clover bacteria is to take moist topsoil from an old clover field and scatter it over the new field at the time the clover is seeded. About 200 to 250 pounds of this old clover soil should be scattered on each acre of new ground and immediately harrowed in. If the inoculated soil dries out, the vigor of the clover bacteria in it is greatly diminished. This is one of the reasons why it should be harrowed in and not simply scattered on top of the ground. Excellent results have been reported by this method of inoculating clover. The danger in this method lies in the possibility of introducing weed pests or plant diseases through the agency of the old soil.

(3) The most scientific method of inoculating the clover field is to obtain a pure culture of clover bacteria and moisten the clover seed with it just before sowing. These pure cultures have been put on the market commercially and can also be obtained in limited quantity from the United States Department of Agriculture.^a

EFFECT OF WINDS ON THE CLOVER CATCH.

Throughout northern Michigan, Wisconsin, and Minnesota there is usually a persistent strong wind that blows steadily from the west and southwest nearly every day in spring and early summer. These winds are frequently very injurious to spring-planted grains on sandy

^a Information as to methods of inoculating soils for various legumes and the benefits derived from inoculation is given in Farmers' Bulletin No. 314, which may be had free upon application to the Secretary of Agriculture.

lands and are especially severe on new clover seeding. Grain fields have been seen where practically all the seeding on the eastern side of the field had been destroyed by drifting sand and the drying effects of the wind. Frequently the clover in exposed fields is entirely killed out, except in sheltered spots like ravines and on hillsides or along fences which break the force of the wind. Time and time again the clover crop in the middle and east side of a field has been found a complete failure while an excellent stand was obtained on the western edge of the field where perhaps a board fence or a few scattering shrubs offered some light protection from the drying winds.

In experimental work on sandy lands in Wisconsin, Professor King^a found that, with a gentle breeze blowing, evaporation a foot above the ground was 25 per cent greater 20 rods out from the west edge of a field than it was 3 rods out. In this case there was a wind-break 12 to 15 feet high on the west side of the field. Even with only a hedge of scattering bur oaks 6 to 8 feet high, evaporation was 30 per cent greater 300 feet to leeward of the hedge than at 20 feet.

Not only does the land dry out much more rapidly with a strong wind blowing over it, but the finer portions of the soil itself may be blown away, greatly decreasing the soil fertility and lessening the power of the soil to hold moisture, for the finer the soil the greater its moisture-holding capacity. These various factors—the wind carrying sand particles which cut off the young plants or cover them over, the more rapid drying out of the soil exposed to the high winds of the spring, and the lessened fertility content of the soil caused by the finer particles being blown away—all tend to decrease the chances of success of the clover plant.

Another point in this connection is that under ordinary conditions of farming the finer particles of soil are brought to the surface every time the land is plowed or tilled. The wind carries many of these away, so that the natural tendency of these soils, if allowed to drift, is to become coarser, less able to retain moisture, and more subject to drought. Besides, in these coarser soils any vegetable matter that may be added in the form of green or stable manure is much more quickly burned out and the humus reduced to ashes than on the finer and more compact soil of the original field. This we do not want. A big yield on these lands depends upon there being a large quantity of humus in them.

WIND-BREAKS FOR SANDY LANDS.

The chances for securing a good catch of clover and a stand of grains are greatly increased by having a wind-break around each field. This can be easily provided by leaving an uncut strip one to two rods

^a Wisconsin Agricultural Experiment Station Bulletin No. 42.

wide around each field at the time the land is cleared. Any blank spaces in this hedge can be filled in by transplanting to it some of the native trees and shrubs, such as jack pines, poplars, Juneberries, scrub oaks, willows, and the like. Spruce also does remarkably well on all jack-pine land and makes an excellent wind-break.

Since also the prevailing winds come from the west and southwest, it is advisable to make the cleared fields comparatively long and narrow, the long way running north and south.

Many a farmer likes to see big fields. It is a pleasure to stand in the doorway and look over the whole farm, seeing nothing but cultivated fields. An overgrown fence row is an abomination that must be grubbed out. Nevertheless the farmer who fails to leave or provide a wind-break around his fields on the sandy lands of the jack-pine plains pays dearly for his negligence. It is one of the little things that make the difference between success and failure on these lands. A hedge row growing around a sandy field is a kind of insurance against failure, especially valuable where success is staked on the clover crop. What may seem like shiftlessness in overgrown fence rows on fertile clay loam farms has been found to be the wisest kind of farming on lighter sandier lands.

Long, narrow fields never more than 40 rods wide, with occasional wind-breaks, are recommended. In most cases the wind-breaks are already in place. They should not be cut down when clearing the fields. If they are not there they should be planted. This will pay a bigger interest on the investment than any other improvement that can be put on the place.

ROUGH FIELDS DESIRABLE ON SANDY LANDS.

Another point bearing on the relation of winds to the method of handling sandy lands may need explanation. After seeding any crop on sandy lands, the packing of the soil down firmly around the seeds by running over the field with a heavy roller is strongly recommended. Soil moisture from below rises more rapidly in firm than in loose soil, resulting in a better and quicker germination of the sown seed. If, however, the soil is left packed to the surface, evaporation from the soil is more rapid than where the topsoil is loose. Besides, where the soil is left smooth after the roller the winds blow over it much more rapidly than where it is left rough.

King^a found that the force of the wind next to the soil surface was reduced about one-half on rolled land by running over it with a harrow. He cites a rolled field over which the wind was raising such a dust that it was almost impossible to see across it. A harrow was run over the field at right angles to the wind, when the cloud of dust

^a Wisconsin Agricultural Experiment Station Bulletin No. 42.

practically subsided. Actual measurements showed that the velocity of the wind across the roughened field next the soil surface was much less—practically half less—than over the rolled smooth soil. Therefore, whenever the soil is packed down smooth with a roller—and this should be after every clover and grain crop is seeded—it should be followed immediately with a spike-tooth harrow to leave the top surface loose and rough.

HANDLING CLOVER FOR SEED.

The usual custom in the north-central part of the southern peninsula of Michigan, where clover is being grown quite extensively for seed on pine and hardwood lands, is to cut the first crop of the season of either common red clover or the larger growing mammoth clover for seed. This is contrary to the general practice in the older clover seed sections farther south, where the usual procedure is to cut the first crop of common red clover for hay and the second for seed. Indeed, the belief is quite prevalent among farmers in the older clover sections that the first crop of June clover does not set seed. That the belief does not hold true in northern Michigan is shown by the fact that there are many authentic records of yields of 6, 8, 10, and, in one instance at least, even 12 bushels of clover seed per acre. These yields have been obtained from the first crop without either clipping or pasturing the clover back in spring. The average yield of clover seed in northern Michigan in fields with a uniform stand of clover is more than 2 and very close to 3 bushels of seed to the acre one year with another, while the better farmers will average 4 to 5 bushels. When, however, in that northern section, the first crop of common red clover is cut for hay and the second left for seed, the seed yield is nearly always disappointing, a yield of half a bushel to a bushel of low-grade seed containing a very large percentage of light and shriveled seed being the rule.

The farmers, however, who are uniformly getting the largest yields of seed in northern Michigan, Wisconsin, and Minnesota are the ones who first pasture back the clover, either common red or mammoth, with sheep or cattle until about June 15 to 20 in a normal season and then let the crop come on for seed. Some farmers who do not have sufficient stock clip the clover back with a mower about June 15 and get as good results as where the clover is pastured off. The mower is set high and the clippings left to fall back on the land. Even where the land is pastured off many farmers practice running over the field with a mower after the stock is removed to clip back any bunches that may be left, so that the crop may come on evenly over the entire field.

The past season, especially, it was a noticeable fact in northern Michigan that those farmers who pastured or clipped back their

clover got larger yields of seed than those who did not. One instance from this year's observation may be cited in this connection. One farmer on the jack-pine plains in northern Michigan had a practically perfect stand of clover on about 50 acres of his farm. This clover was waist-high and full of blossoms in July, promising an extra heavy yield. It thrashed out a little more than 2 bushels of seed to the acre. A near-by farmer on similar sandy lands pastured back his rather poor stand of clover on a 40-acre field with cattle until June 20. This field averaged about 5 bushels of seed per acre.

REASONS FOR PASTURING CLOVER OR CLIPPING IT BACK.

Farmers have found from experience that by pasturing or clipping back clover and then letting the crop go to seed they get larger yields of seed generally than by any other method of handling the crop. The reasons generally given for such better yields are about as follows: By clipping or pasturing back, the clover is brought into bloom in a dry time. One farmer expressed it thus: "I don't care how much rain there is up to the time clover blooms, but after that a good seed crop depends upon dry weather." If rainy weather prevails during the blooming period the clover crop may as well be cut for hay.

Again, it is believed that by pasturing or clipping back, the plant does not grow so rank, is less likely to lodge and fall down, blooms more freely, and that a larger number of insects are present to cross-fertilize the crop than earlier in the season. Another advantage of pasturing back is that there is much less straw to handle at thrashing time. This is an item of special importance where the large mammoth clover is grown. A rank yield of plant and a large yield of seed do not appear to go together, but rather where the plant is rankest there the seed yield is least.

THE CLOVER-FLOWER MIDGE.

More pertinent, probably, than all the reasons previously given for pasturing or clipping back clover is the fact that by so doing the destructive action of the clover-flower midge is largely avoided. The clover-flower midge is usually noticed on the clover heads as a small orange-red insect about as large as a pin head, commonly present in all clover sections of the United States and observed by the writer the past season in northern Michigan, Wisconsin, and Minnesota. This insect feeds within the florets of the clover blooms at blossoming time and prevents the formation of seed. It probably does more to injure the seed crop than all other agencies combined except wet weather.

A detailed description and life-history account of the flower midge can not be given here, but the farmer who may be interested in clover-seed production is urged to write to the United States Department of

Agriculture for Bureau of Entomology Circular No. 69, entitled "Some Insects Affecting the Production of Red Clover Seed."

FACTORS IN SUCCESSFUL CLOVER-SEED FARMING.

Practice and science unite in showing that to secure the largest crop of clover seed the crop should bloom during dry weather. This necessitates keeping an account of the weather in each locality from year to year so as to know at about what period to expect dry weather. The plants should be comparatively thin on the ground and stocky for the largest yield. Closely crowded plants make weak stems which lodge and produce very little seed. Pasturing or clipping tends to make short straw and stocky plants, which are less likely to lodge and easier to handle at thrashing time. To avoid the greatest injury from the flower midge the crop should be brought into bloom a little later than the first crop of common red clover normally blooms and considerably earlier than the second crop of this clover usually blooms. This is brought about by pasturing the clover back until about June 15 to 20 in the northern part of Michigan, Wisconsin, and Minnesota, or clipping it back with the mower at about this time.

HARVESTING AND CURING CLOVER FOR SEED.

Practice varies as to the time for cutting common red and mammoth red clover for seed. The greatest quantity of seed is usually obtained by waiting until about 95 per cent of the heads are a dead, brown color, but before any of the heads begin to fall to pieces. A number of instances came under the writer's observation the past season where the crop was cut a little on the green side with the expectation that the

seed would ripen up in curing. The results were quite uniformly unsatisfactory, much of the seed being shriveled and light. Where the crop is left until most of the heads are thoroughly ripe there is less loss of heads if the cutting

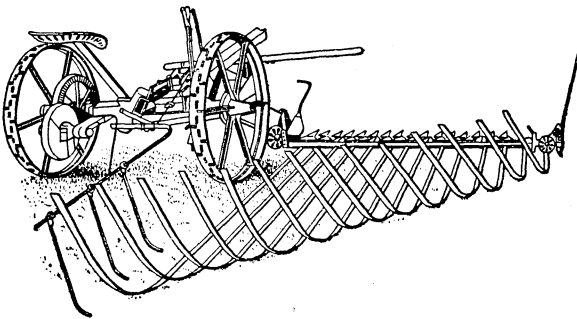


FIG. 1.—Mower with attachment for bunching clover cut for seed.

is done in the early morning and late afternoon when the straw is a little tougher than at midday.

In cutting, farmers quite generally use a finger-like attachment to the mower with a trip worked by the foot. (See fig. 1.) This leaves the clover in bunches out of the way of the trampling of the horses.

After five or six days' curing in these bunches, if the weather conditions are favorable, the crop is thrashed direct from the field. One or two rains on the crop do not injure it, but with continued wet weather many seeds sprout and the quality of the crop is injured. If a clover huller is not available as soon as the crop is dry enough to hull, the clover should be stacked or put under cover in barns or sheds. When stacked or put into the mow the clover undergoes a sweating process. On this account hulling should be delayed at least three weeks after stacking.

Stacking is always a safe way of handling the clover-seed crop. Fall rains of a month to six weeks' duration are not infrequent in the Northern States, during which time if the clover is lying in the field the greater part of the seed is lost by the heads rotting off or disintegrating and by the seeds sprouting and becoming discolored. The stack must be covered with straw, marsh hay, or the like, to turn water. The crop is too valuable to take chances with, and the extra labor involved in stacking is not too much insurance to pay for the certainty of securing the crop in the best possible condition.

CLOVER STRAW.

When clover is cut for seed and cured quickly without rainfall the straw has some feeding value. Some farmers use it as a substitute for hay for sheep and cattle. If not required to eat it up too close, stock get along on such material about as well as they do on oat straw. But where the clover has lain in the field subject to dews and rains it gets more or less brittle and rotten and should be used only for bedding or manure.

Many farmers who thrash directly from the field spread the straw out thinly over the field as a manure. For this purpose it is worth about \$8 a ton; that is, the amount of fertility in a ton of clover straw if bought in commercial form would cost \$8. When this material is used as a light top-dressing on grain it aids in securing a stand of clover; in fact, the straw frequently contains considerable quantities of unthrashed seed which helps considerably in reseeding either old or new fields where it may be applied.

CLOVER FOLLOWING CLOVER.

Clover being the most paying crop yet found for the jack-pine lands, can it be grown year after year on the same land? Mr. Hubbard Head, of Roscommon County, Mich., has asked this question of the jack-pine lands and has been answered in the affirmative. For as many as fifteen years Mr. Head has grown clover continuously on the same fields, and the crop of 1907 was perhaps the best of all. Indeed, by the continuous culture of clover the naturally loose, sandy

soil had become firm and compact, the color of the soil decidedly darker, and its fertility greatly increased.

On this farm the general plan is to cut clover for hay or seed until the clover in the field becomes thin; then to let the crop grow until about July, when the whole crop is turned under and the field rolled and reseeded to clover. The seed is sown at the rate of 3 quarts to the acre and harrowed in about 2 inches deep. Thus handled it has become possible, as the land has improved, to secure two, and sometimes three, clover crops in succession before it is found necessary to plow the field down again and reseed. Likewise it has become possible to seed such old clover land in early spring and get a crop of hay or even a small crop of seed the same season.

Frequently, however, bluegrass—or, as it is generally known in the Northern States, June-grass—gets into the clover field and becomes a pest, so that before the field is reseeded to clover it will be found best to put it into some cultivated crop, such as potatoes or corn, for a year or two. It is probable also that if the farm is near a railroad town more money can be made one year with another by alternating potatoes or other vegetable crops with clover than by growing clover continuously. Twelve to fifteen miles away from a railroad the growing of clover for seed alone may be the most profitable form of farming, in which case as much as possible of the farm should be continuously in clover.

MANURES AND FERTILIZERS.

MANURES.

The man who has even a small quantity of manure to apply on the jack-pine land will be astonished at the result. In this light, warm soil the full value of the manure seems to be effective on the crop at once. The crop comes up vigorous and strong, with a healthy color, and makes a rapid growth to maturity. When one is growing clover for seed the best method of applying the manure is as a comparatively light top-dressing on meadows in spring. When clover is seeded with grain in the spring the chances of success of the clover crop are greatly increased by a light top-dressing. An application of even 3 or 4 tons an acre has a marked beneficial effect and practically makes certain a full stand of clover where the manure is evenly spread over the surface.

When corn or potatoes are grown after clover sod, the sod should be plowed under in the fall and what manure is used should be applied as a top-dressing in the spring. In the case of either of these crops the manure can be lightly disked in. When clover is seeded in standing corn—a very desirable practice—the manure used as a top-dressing is of decided advantage in securing a good stand of clover.

Now, there is a difference in manures. The solid matter excreted contains barely half as much plant food in it as the solid and liquid manures combined. One of the first things the plains farmer needs to look after, then, is water-tight stalls and gutters and the use of enough bedding to absorb all the liquids. After the manure is made, the sooner it is applied on the land the more value the crops will get out of it. The best method of producing and caring for manure is told in another bulletin of this Department, which may be had for the asking.^a Here we wish to emphasize only the desirability of saving the liquid as well as the solid manure by having water-tight floors and gutters, and using the manure in frequent light top-dressings rather than occasional heavy applications turned under.

FERTILIZERS.

Commercial fertilizers have scarcely been used as yet on the jack-pine plains. Superphosphates in a few instances have been found very beneficial to clover, more so than barnyard manure, but on grasses top-dressings of barnyard manure have given larger increases than when superphosphates were used.

Quite extensive experiments a few years since were made by Dr. R. C. Kedzie,^b of the Michigan Agricultural Experiment Station, in using marl, plaster, and salt on jack-pine lands. Marl had an immediate and lasting beneficial effect on the plains and no injury resulted from its free application at any time. Marked benefit resulted from the use of land plaster up to 200 pounds an acre on nearly all crops, but no benefit was found with any crop from the use of salt as a manure. Splendid results are also being reported on the use of commercial fertilizers by the Wisconsin subexperiment station located in the northern part of that State, at Iron River, on a very good quality of sandy cut-over pine and jack-pine land.

SUMMARY AND SUGGESTIONS.

(1) There are millions of acres of jack-pine lands in Michigan, Wisconsin, and Minnesota that can be made into profitable farms if special care is taken to till the soil properly and follow a type of farming suited to the locality and soil.

(2) The successful farming of these lands is based on the fact that clover will grow on them.

(3) A type of farming which is proving profitable on these lands is the growing of clover for seed.

(4) The kind of clover that grows best and gives the largest yields of seed is the mammoth variety.

^a Farmers' Bulletin No. 192, entitled "Barnyard Manure."

^b Report of the Michigan State Board of Agriculture, 1889.

(5) The most certain way to succeed with the clover crop is to break new ground shallow in midsummer without burning over, cultivate with a disk harrow, sow the seed 2 inches deep the following spring without a nurse crop, cover with a heavy roller, and then run over with a light spike-tooth harrow to leave the topsoil loose and rough.

(6) The best time to break new ground on the jack-pine plains is during July, after the native vegetation has made its maximum growth for the season. Breaking should be done shallow—not more than about 4 inches deep.

(7) The chances for a successful clover catch are greatly increased by making the fields comparatively narrow east and west, and leaving a good hedge of native trees and shrubs along the west and north borders of every field for a wind-break.

(8) The clover crop is greatly benefited on the jack-pine soils by light top-dressings of barnyard manure or of superphosphates. Marl is also beneficial, and land plaster up to 200 pounds to the acre.

(9) Jack-pine lands are not uniform in character. Open plains and light vegetation generally indicate the poorest grade; mixed vegetation, luxuriant on the ground, and an abundance of willows, Juneberries, poplars, maples, briars, etc., indicate better grades. All the better grades of jack-pine lands can be made into profitable farms by growing clover.

(10) It requires an intelligent understanding of the principles of farming to obtain success on these naturally light lands. It takes about three years' time to get the farm on a paying basis. The first year, at least, the settler must have enough money on hand to carry him through, or he must be prepared to work out part of the time.

(11) If the settler will get his land into mammoth clover as soon as he can, keep it in clover as much of the time as possible, and make clover the main crop on his farm for five or six years, he will build up a fertile, profitable farm upon which he can carry out any type of farming suitable to the region.